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Takeo Yamaguchi

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EXAMINER

DOUYETTE, KENNETH J

ART UNIT

PAPER NUMBER

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/524,340	<b>Applicant(s)</b> YAMAGUCHI ET AL.	
	<b>Examiner</b> KENNETH DOUYETTE	<b>Art Unit</b> 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 18 September 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,2,16,17,39-41 and 43-74 is/are pending in the application.  
4a) Of the above claim(s) 42, 64 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,16,17,39-41,43-63 and 65-74 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Response to Amendment*

1. Claims 1-2, 16-17, 39-41, 43-63, and 65-74 are pending in the application.
2. The amendment received September 18, 2009 successfully traverses the claim objections of the June 18, 2009 first office action.
3. New grounds of rejection have been introduced, necessitated by the September 18, 2009 amendment.

### *Claim Rejections - 35 USC § 103*

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
5. Claims 1-2, 16-17, 39-41, 43-56, 60-63, and 65-74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. ("Effect of diffusion-layer morphology on the performance of polymer electrolyte fuel cells operating at atmospheric pressure") in view of Bruck et al. (US 6,376,118).

Regarding claim 1, Jordan et al. discloses an electrode (P641/C2/¶4) for a fuel cell (Title) comprising a porous (P643/C1/¶1) electron-conductive material ("Vulcan XC-72", P641/C2/¶3), a catalyst ("Pt", P641/C2/¶3), and a proton-conductive substance ("NAFION ionomer solution", P642/C1/¶1),

- wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1);

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- the catalyst (P641/C2/¶3) is loaded (P641/C2/¶4) on the porous electron-conductive material (P641/C2/¶3);
- the proton-conductive substance (P642/C1/¶1) is arranged in the vicinity of (P642/C1/¶1, P641/C1/¶2) the catalyst (P641/C2/¶3); and
- the proton-conductive substance (P642/C1/¶1) is comprised of a proton-conductive substance precursor, a proton-conductive monomer or an equivalent thereto, or polymers ("NAFION ionomer solution", P642/C1/¶1) thereof.

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve

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ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Regarding claim 2, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the catalyst is a noble metal catalyst ("E-TEK", same material as instant specification, P641/C2/¶3).

Regarding claim 39, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the catalyst is Pt (P641/C2/¶3) or Pt-Ru.

Regarding claim 40, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the porous (P643/C1/¶1) electron-conductive material (P641/C2/¶3) is a carbon-based porous (P643/C1/¶1) electron-conductive material ("Vulcan XC-72", P641/C2/¶3).

Regarding claim 41, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the carbon-based porous electron-conductive material (P641/C2/¶3) is selected from the group consisting of carbon black ("Vulcan XC-72", P641/C2/¶3), acetylene black (P641/C2/¶2), graphite, carbon fiber ("paper", P641/C1/¶2), carbon nanotube, fullerene, activated carbon, and glass carbon.

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Regarding claim 43, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) is not caused to flow out by a cell power generation operation (indicated by performance results, P643-645) from the surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) or in the vicinity thereof.

Regarding claim 44, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses one end (via "layers", P641/C2/¶4) of the proton-conductive substance (P642/C1/¶1) is bound to the surface of the porous electron-conductive material (P641/C2/¶3) through a chemical bond ("sintered", P641/C2/¶4). Sintering produced chemical changes and bonds between materials as evidenced by Remmy ("Firing Ceramics", P1-13). Therefore, after sintering, chemical bonds between layers (or one end of a material) are formed.

Regarding claim 45, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance has a sulfonic group (-SO<sub>3</sub>H) ("NAFION ionomer solution", P642/C1/¶1), a phosphoric group or a carboxyl group.

Regarding claim 46, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) is a proton-conductive polymer ("NAFION ionomer solution", P642/C1/¶1) having a sulfonic

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group (-SO<sub>3</sub>H) ("NAFION ionomer solution", P642/C1/¶1), a phosphoric group or a carboxyl group.

Regarding claim 47, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) has a hydrophobic site (P641/C1/¶2), and the substance (P642/C1/¶1) is adsorbed in a hydrophobic (P641/C1/¶2) manner to the surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) via the hydrophobic site (P641/C1/¶2).

Regarding claim 48, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) is a proton-conductive polymer ("NAFION ionomer solution", P642/C1/¶1), the polymer having a hydrophobic site (P641/C1/¶2) and the polymer being adsorbed in a hydrophobic (P641/C1/¶2) manner to the surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) via the hydrophobic site (P641/C1/¶2).

Regarding claim 49, modified Jordan et al. discloses a fuel cell (Title) having an electrode (P641/C2/¶4) for a fuel cell as set forth above.

Regarding claim 50, modified Jordan et al. discloses a solid polymer fuel cell (P641/C1/¶1) having an electrode (P641/C2/¶4) for a fuel cell as set forth above.

Regarding claim 51, modified Jordan et al. discloses an electrode (P641/C2/¶4) for a fuel cell (Title) as set forth above but does not explicitly disclose a direct methanol fuel cell.

Bruck et al. discloses an electrode (Abstract) for a fuel cell that uses methanol as a fuel (C2/L14-15).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the electrode of Jordan et al. into a direct methanol fuel cell as disclosed by Bruck et al. since said combination would amount to use of a known element for its intended use in a known environment to accomplish entirely expected result.

Regarding claim 16, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3), wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1);
- (b) forming a proton-conductive substance (P642/C1/¶1) on a surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) or in the vicinity thereof (P642/C1/¶1); and
- (c) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2), thereby forming the proton-conductive



substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Further, regarding limitations in claim 16 reciting interchangeable steps, selection of any order of performing process steps is prima facie obvious in the absence of new or

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unexpected results. See also *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946) and *Ex parte Rubin*, 128 USPQ 440 (Bd. App. 1959).

Regarding claim 60, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the catalyst is a noble metal catalyst ("E-TEK", same material as instant specification, P641/C2/¶3).

Regarding claim 61, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the catalyst is Pt (P641/C2/¶3) or Pt-Ru.

Regarding claim 62, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the porous (P643/C1/¶1) electron-conductive material (P641/C2/¶3) is a carbon-based porous (P643/C1/¶1) electron-conductive material ("Vulcan XC-72", P641/C2/¶3).

Regarding claim 63, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the carbon-based porous electron-conductive material (P641/C2/¶3) is selected from the group consisting of carbon black ("Vulcan XC-72", P641/C2/¶3), acetylene black (P641/C2/¶2), graphite, carbon fiber ("paper", P641/C1/¶2), carbon nanotube, fullerene, activated carbon, and glass carbon.

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Regarding claim 65, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) is not caused to flow out by a cell power generation operation (indicated by performance results, P643-645) from the surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) or in the vicinity thereof, especially in the pores (see Bruck et al., instant claim 16 rejection).

Regarding claim 66, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses one end (via "layers", P641/C2/¶4) of the proton-conductive substance (P642/C1/¶1) is bound to the surface of the porous electron-conductive material (P641/C2/¶3) through a chemical bond ("sintered", P641/C2/¶4). Sintering produced chemical changes and bonds between materials as evidenced by Remmy ("Firing Ceramics", P1-13). Therefore, after sintering, chemical bonds between layers (or one end of a material) are formed.

Regarding claim 67, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance has a sulfonic group (-SO<sub>3</sub>H) ("NAFION ionomer solution", P642/C1/¶1), a phosphoric group or a carboxyl group.

Regarding claim 68, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) is a

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proton-conductive polymer ("NAFION ionomer solution", P642/C1/¶1) having a sulfonic group (-SO<sub>3</sub>H) ("NAFION ionomer solution", P642/C1/¶1), a phosphoric group or a carboxyl group.

Regarding claim 69, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) has a hydrophobic site (P641/C1/¶2), and the substance (P642/C1/¶1) is adsorbed in a hydrophobic (P641/C1/¶2) manner to the surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) via the hydrophobic site (P641/C1/¶2).

Regarding claim 70, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the proton-conductive substance (P642/C1/¶1) is a proton-conductive polymer ("NAFION ionomer solution", P642/C1/¶1), the polymer having a hydrophobic site (P641/C1/¶2) and the polymer being adsorbed in a hydrophobic (P641/C1/¶2) manner to the surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) via the hydrophobic site (P641/C1/¶2).

Regarding claim 71, modified Jordan et al. discloses a method for producing a fuel cell (Title), comprising the steps of:

- using electrodes (P641/C2/¶4) for a fuel cell (Title) obtained with a method as set forth above as a cathode (P641/C1/¶2) and/or an anode (P641/C1/¶2); and

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- arranging the cathode and/or the anode (P641/C1/¶2) so as to sandwich an electrolyte (“membrane”, P641/C1/¶2) there between (“MEA”, P641/C1/¶2).

Regarding claim 72, modified Jordan et al. discloses all of the claim limitations as set forth above and also discloses the assembly (“MEA”, P641/C1/¶2) is a catalyst layer (P641/C2/¶3) formed on one or both (P642/C1/¶1) of the electrodes (P641/C2/¶4) for a fuel cell (Title).

Regarding claim 17, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3), wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1);
- (b) forming a proton-conductive substance (P642/C1/¶1) on a surface (P641/C1/¶2) of the porous electron-conductive material (P641/C2/¶3) or in the vicinity thereof (P642/C1/¶1); and
- (c) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly (“MEA”, P641/C1/¶2), wherein the steps can be changeable in the order thereof, thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Further, regarding limitations in claims 17 and 52-56 reciting interchangeable steps, selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. See also *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946) and *Ex parte Rubin*, 128 USPQ 440 (Bd. App. 1959).

Regarding claim 52, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3), wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1);
- (b) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2); and then
- (c) forming a proton-conductive substance (P642/C1/¶1) on the porous electron-conductive material (P641/C2/¶3), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8),

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improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Regarding claim 53, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) forming a proton-conductive substance (P642/C1/¶1) on the porous electron-conductive material (P641/C2/¶3), wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1);
- (b) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3); and then
- (c) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).



While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Regarding claim 54, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

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- (a) forming a proton-conductive substance (P642/C1/¶1) on the porous electron-conductive material (P641/C2/¶3), wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1); thereafter
- (b) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2); and then
- (c) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

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Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Regarding claim 55, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2), wherein the pores (P643/C1/¶1) of the porous electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1), into an assembly; thereafter,
- (b) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3), which is a part of the assembly; and then
- (a) forming a proton-conductive substance (P642/C1/¶1) on the porous electron-conductive material (P641/C2/¶3), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Regarding claim 56, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2), wherein the pores (P643/C1/¶1) of the porous

electron-conductive material (P641/C2/¶3) have an average diameter of 1 nm to 100 nm (P643/C1/¶1), into an assembly; thereafter,

- (b) forming a proton-conductive substance (P642/C1/¶1) on the porous electron-conductive material (P641/C2/¶3), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3); and then
- (c) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

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Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Regarding claim 73, Jordan et al. discloses a method for producing an electrode (P641/C2/¶4) for a fuel cell (Title), comprising the steps of:

- (a) causing a catalyst (P641/C2/¶3) to be loaded (P641/C2/¶4) on a porous electron-conductive material (P641/C2/¶3);
- (b) binding (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) a proton-conductive substance (P642/C1/¶1) on the porous electron-conductive material (P641/C2/¶3); and
- (c) transforming the porous electron-conductive material (P641/C2/¶3) into an assembly ("MEA", P641/C1/¶2), thereby forming the proton-conductive substance (P642/C1/¶1) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), and this material bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to a proton

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conductive substance (P642/C1/¶1), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).

Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

Further, regarding limitations in claim 16 reciting interchangeable steps, selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. See also *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946) and *Ex parte Rubin*, 128 USPQ 440 (Bd. App. 1959).

Regarding claim 74, Jordan et al. discloses an electrode (P641/C2/¶4) for a fuel cell (Title) comprising a porous (P643/C1/¶1) electron-conductive material ("Vulcan XC-72",

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P641/C2/¶3), a catalyst ("Pt", P641/C2/¶3), and a proton-conductive substance ("NAFION ionomer solution", P642/C1/¶1),

- wherein the catalyst (P641/C2/¶3) is loaded (P641/C2/¶4) on the porous electron-conductive material (P641/C2/¶3);
- the proton-conductive substance (P642/C1/¶1) is comprised of a proton-conductive substance precursor, a proton-conductive monomer or an equivalent thereto, or polymers ("NAFION ionomer solution", P642/C1/¶1) thereof, and
- the proton-conductive substance (P642/C1/¶1) is bound (mixed with "NAFION ionomer solution", P642/C1/¶1, and "sintered", P641/C2/¶4) to the proton-conductive material (P641/C2/¶3) in the vicinity of (P642/C1/¶1) the catalyst (P641/C2/¶3).

While Jordan et al. discloses a catalyst is loaded (P641/C2/¶4) onto a 1-100 nm porous Vulcan XC-72 material (P641/C2/¶3), it does not explicitly disclose the catalyst is disposed within the pores.

Bruck et al. discloses in Fig 3, an electrode (Abstract) comprising porous (ref 3) proton conducting material (C4/L46-47) with a catalyst (ref 8) carried in (Fig 3, C3/L30) the pores (ref 3). This configuration aids in ionization of fuel and oxidant (C2/L5-8), improving performance, permeability (C2/L41-45), and overall power generation capabilities of the fuel cell (C2/L35-38).



Bruck et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a catalyst disposed in the pores of an electron conductive material as disclosed by Bruck et al. in the electrode of Jordan et al. to improve ionization capabilities of fuel and oxidant, improve permeability, and enhance overall power generating capabilities of a fuel cell into which the electrode is disposed.

6. Claims 57-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. ("Effect of diffusion-layer morphology on the performance of polymer electrolyte fuel cells operating at atmospheric pressure") in view of Bruck et al. (US 6,376,118) as applied to claim 16 above and further in view of Cavalca et al. (US 2001/0033960).

Regarding claim 57 and 58, modified Jordan et al. discloses all of the claim limitations as set forth above but does not disclose the step (b) has a modification step of modifying the surface of the porous electron-conductive material, nor that the modification step is inserted before the proton-conductive substance is disposed on the surface.

Cavalca et al. discloses in Figs 1-3, an electrode (refs 1, 3) for a fuel cell (Abstract) comprising an electrically conductive particulate material ([0115]) carrying a catalyst ([0099]). The reference discloses a modification step ("can be used directly or with

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modification", [0110], "pre-treat", [0307]) of modifying the surface ("interfacial regions", Fig 2, references 4 and 5, [0097], [0141]) of the electrically conductive particulate material ([0115]). This configuration allows for enhanced binding of the catalyst layers ([0115]), resulting in a structure that is capable of producing increased power over prior art ([0018]).

Cavalca et al. and Jordan et al. are analogous since both deal in the same field of endeavor, namely, fuel cells.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the surface modification of the electron-conductive material as disclosed by Cavalca et al. into the method of Jordan et al. to enhance binding of catalyst layers within the electrode structure, enhancing potential power output of the fuel cell.

Further, regarding limitations in claim 58 reciting interchangeable steps, selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. See also *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946) and *Ex parte Rubin*, 128 USPQ 440 (Bd. App. 1959).

Regarding claim 59, modified Jordan et al. discloses all of the claim limitations as set forth above but does not disclose the step of forming a proton-conductive substance is a step in which a methylol group is introduced onto the porous electron-conductive material and the methylol group is reacted with a proton-conductive substance precursor, to form the proton-conductive substance.

Cavalca et al. discloses in Figs 1-3, an electrode (refs 1, 3) for a fuel cell (Abstract) comprising an electrically conductive particulate material ([0115]) carrying a catalyst ([0099]). The reference further discloses the step of forming a proton-conductive substance is a step in which a methylol group (2-methyl-1-propyl alcohol, [0117]) is introduced onto the porous electrically conductive particulate material ([0115]) and the methylol group ([0117]) is reacted with a proton- conductive substance precursor ("polymeric binder", [0115]), to form an ionically conducting perfluorinated ionomer ([0099]). This configuration allows for enhanced binding of the catalyst layers ([0115]), resulting in a structure that is capable of producing increased power over prior art ([0018]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the methylol modification of the electrically-conductive particulate material as disclosed by Cavalca et al. into the method of Jordan et al. to enhance binding of catalyst layers within the electrode structure, enhancing potential power output of the fuel cell.

### ***Response to Arguments***

7. Applicant's arguments with respect to claims 1-2, 16-17, 39-41, 43-56, 60-63, and 65-72 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KENNETH DOUYETTE whose telephone number is (571)270-1212. The examiner can normally be reached on Monday - Thursday 6am - 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Basia Ridley can be reached on (571) 272-1453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/K. D./

Examiner, Art Unit 1795

/Jonathan Crepeau/

Primary Examiner, Art Unit 1795